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In re Application of:	)	
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Marco CANTU' et al.	)	Group Art Unit:
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Serial No.: Not yet assigned	)	
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Filed: December 3, 2001	)	
	)	
For: SYSTEM FOR CHECKING THE AIR PRESSURE IN THE TYRES OF A MOTOR VEHICLE	)	

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

TRANSMITTAL FOR THE LITERAL TRANSLATION OF THE PROVISIONAL APPLICATION UNDER 35 U.S.C. 119(e) AND VERIFIED TRANSLATION

Enclosed is the literal translation of the Provisional Application Serial No 60/147,476 which was filed on June 14, 1999. The translation is being filed in accordance with 37 CFR 1.78(a) and within the time period set forth in 37 CFR 1.78(a)(5). Also enclosed is a verification by the translator testifying to the accuracy of the translation.

Authorization is hereby given to charge any fees associated with this matter to our deposit account no. 06-0916.

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Dated: December 3, 2001

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Copy of English translation of U.S. Provisional Application No. 60/147,076, filed June 14, 1999, with verification by Translator7

PT122

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I, Luca BROCCOLO

of Pirelli S.p.A. of Viale Sarca 222, 20126 Milan, Italy, declare:

1. That I am a citizen of Italy.
2. That I am well acquainted with the Italian and English languages.
3. That the attached is, to the best of my knowledge and belief, a true translation into the English language of the specification in Italian filed with the provisional application in the UNITED STATES entitled:

"SYSTEM FOR CHECKING THE AIR PRESSURE IN THE TYRES OF A MOTOR VEHICLE"

4. That I believe that all statements made herein of my own knowledge are true and that all statements made on information and belief are true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of title 18 of the United States Code and that such willful false statements may jeopardize the validity of the patent application in the United States of America or any patent issuing thereon.

Luca Broccolo

For and on behalf of Pirelli S.p.A.

This 30th day of August 1999

"SYSTEM FOR CHECKING THE AIR PRESSURE IN THE TYRES OF A MOTOR VEHICLE"

The present invention relates to a system and to a method for checking the inflation pressure of the tyre, to a tyre wheel and to an inner tube comprising devices for checking the inflation pressure of the tyre.

The wheel is the component providing a connection between vehicle and road; it performs the function of providing support of the pneumatic type to the vehicle and to its load and of ensuring, by means of the tyre, an adequate road-holding performance.

Support of the vehicle is provided by the volume of pressurised air contained inside the wheel; for this purpose one of the adopted solutions consists in the use of an inner tube which is inserted between tyre and rim and inflated with pressurised air introduced into the inner tube by means of an inflation valve projecting outside the wheel.

More precisely, the wheel comprises a tyre defining a toroidal cavity, mounted on a corresponding rim, which has a bottom surface provided with a central well and two bead seats against which the tyre beads come into abutment and which are each axially delimited between an end radial surface (shoulder) in an axially external position and an opposing, axially internal, annular projection.

The inner tube, which is inserted between tyre and rim, comprises an expandable torus-shaped tubular body which is generally made of elastomer material and is inflatable by means of an associated inflating valve.

The valve for inflating the inner tube usually comprises a base for connection to the inner tube and a cylindrical casing (stem) which is fixed to the base

and which has arranged inside it the activation mechanism for the inflation and deflation operations.

The Applicant has filed European Patent Application No. 98830079.4 which described an inner tube, characterized in that its valve, necessary for the inflation and deflation thereof, has no parts for connection to the external environment which pass through the rim.

In particular, the valve performs three functions, namely it allows inflation, rapid deflation and calibration of the inner tube to the desired pressure value.

A tyre which is not correctly inflated reduces the efficiency of the vehicle; it produces in particular an increase in the fuel consumption, a deterioration in the behavioural performance, and a greater wear of the tyre, to mention only the main drawbacks.

It is therefore of the utmost importance to be able to monitor continuously the trend of the pressure in the tyres of the vehicle.

Documents which describe systems for automatically monitoring the pressure of tyres are known. These systems send a signal correlated to the pressure value of the tyre to a receiver able to display said value and/or alert the driver as to a possible deviation of the pressure value from a predefined level.

Some of these systems are, for example, described in the American Patents US-5,540,092, US-5,109,213 and US-5,573,611.

These documents describe, respectively, pressure detection devices and the respective transmitters mounted in the stem of the inflation valve, or on the rim wall, or inside the structure of the tyre.

The present invention is based on the perception that the problem of the reliability of the abovementioned devices depends on their position on the constituent parts of the wheel.

The Applicant has noted that, in the first case, these devices interfere with the mechanism for actuation of the valve itself, increase the cost thereof and complicate the construction thereof, reducing its reliability.

In the second case, this solution is suitable only for tubeless tyres and, in view of the position where they are mounted, said devices risk being damaged for accidental reasons.

In the third case, they interfere with the structure of the tyre and may damage it.

The Applicant has noted that the system of the known art cannot be easily replaced in the event of breakage and it is difficult to replace their supply battery when discharged. The Applicant has also noted that these systems may be damaged during operation of the tyre.

The Applicant has also noted that it is preferable not to modify the construction process as well as the structure itself of the tyre.

The Applicant has found that the solution to the abovementioned problems may consist in arranging the pressure detection device and the signal transmitter in a wall of the inner tube.

According to a first aspect thereof, the present invention relates to a system for checking the air pressure in the tyres of a motor vehicle, comprising:

- at least one vehicle tyre wheel, said wheel comprising a tyre mounted on the corresponding mounting rim, defining a toroidal cavity;
- an inner tube inserted in said toroidal cavity;
- a device for detecting the pressure of said inner tube;
- a transmission device designed to transmit a signal indicating the value of said pressure;
- a receiving device designed to receive said signal indicating the pressure value; and
- a device for displaying said signal indicating the pressure value,

characterized in that said transmission device is inserted in said inner tube.

Preferably, said transmission device is inserted in a wall of said inner tube in a radially internal position.

In particular said inner tube comprises a bush and said transmission device is mounted on said bush.

Preferably said transmission device comprises said pressure detector.

Preferably, the system comprises an inflation device inserted in a wall of said inner tube.

Preferably, said transmission device is inserted in a wall of said inner tube in a diametrically opposite position (at 180°) with respect to said inflation device.

In one embodiment said toroidal cavity can be isolated from a surrounding environment at atmospheric pressure and comprises an inflation device which has no parts for connection to said surrounding environment at atmospheric pressure and is inserted in a wall of said inner tube and suitable to fix the circumferential

position of said tube with respect to the rim.

Preferably said inner tube comprises at least two compartments which are separate from each other and each provided with said inflation device.

In particular, said inner tube comprises two inflation devices and one transmission device.

Preferably, said inflation device comprises a rigid body incorporating an inflation valve, a calibration valve and a discharge valve.

Preferably, said transmission device comprises a supply battery and a device for measuring the voltage of said battery and transmitting the value of the measured voltage; preferably it also comprises a movement sensor suitable to indicate the rotation of said wheel so that said transmission device is energised only when the wheel is moving.

According to a second aspect thereof, the present invention relates to a method for checking the air pressure in the tyres of a motor vehicle, characterized by the fact of mounting a transmission device, designed to transmit a signal indicating the pressure value of a tyre, on an inner tube, preferably in a position radially inside the latter.

According to a third aspect thereof, the present invention relates to a tyre wheel for vehicles, comprising:

- a tyre mounted on the corresponding mounting rim, defining a toroidal cavity;
- an inner tube inserted in said toroidal cavity;
- a device for detecting the pressure of said inner tube;
- a transmission device designed to transmit a signal indicating the value of said pressure,

characterized in that said transmission device is inserted in a wall of said inner tube.

According to a fourth aspect thereof, the present invention relates to an inner tube for tyres of vehicle wheels, which is elastically expandable by introducing fluid under pressure into its internal volume, said inner tube being housed in the cavity defined by the tyre mounted on the corresponding rim, comprising a device for introducing and extracting said fluid respectively into and from said internal volume, a device designed to transmit a signal indicating the pressure value of said inner tube, characterized in that said transmission device is inserted in a wall of said inner tube.

Further features and advantages will appear more clearly from the detailed description of a preferred, but not exclusive, embodiment of the different aspects of the present invention.

This description will be provided hereinbelow with reference to the accompanying drawings, provided solely for illustrative purposes and therefore of a non-limiting nature, in which:

- Figure 1 shows a block diagram of the transmission section of the device for checking the air pressure;
- Figure 2 shows a block diagram of the receiving section of the device for checking the air pressure;
- Figure 3 shows an embodiment of the transmission section of the device for checking the air pressure;
- Figure 4 shows a cross section of an inner tube of a tyre according to an embodiment of the present invention;
- Figure 5 shows a partial axial right cross section of a tyre mounted on the respective rim comprising an inner tube;
- Figure 6 shows an embodiment of an inner tube

according to the invention;

- Figure 7 shows a cross section of an inner tube of a tyre according to a different embodiment of the present invention;
- Figure 8 shows a cross section of an inner tube of a tyre according to a further embodiment of the present invention.

Figure 1 shows the block diagram of transmitter 600 of the device for checking the air pressure in the tyres of a vehicle. It is a battery-supplied electronic circuit which transmits by means of electromagnetic waves, preferably at short-wave radiofrequency, in a frequency range of between 100 kHz and 1000 MHz, even more preferably in digital form, information relating to the operating parameters of the tyres, in particular, but not exclusively relating to the inflation pressure. Said transmitter 600, which is installed inside each tyre of the motor vehicle comprises both the electronic circuit and the supply battery. In order to keep the dimensions as small as possible, transmitter 600 uses preferably, in a manner known per se, SMD (Surface Mounting Device) technology for mounting of the components, while, in order to reduce consumption to a minimum, electronic components of the CMOS type are preferably used.

This transmitter 600 comprises a battery 601 which represents the energy source for powering transmitter 600. It preferably consists of various lithium elements which are inserted inside a special container and connected in series; battery 601 provides a voltage of 4.0 V and has a capacity of 150 mAh.

Battery 601 is connected to a voltage regulator 603 which regulates the supply voltage supplied by battery 601, stabilising it at 3 V. Voltage regulator 603 is preferably an integrated circuit with a low intake current and minimum input/output voltage difference, for example the integrated circuit MC78LC30

manufactured by Motorola.

The output of voltage regulator 603 is connected to a microcontroller 604 (for example PIC16LC711 manufactured by Microchip).

Microcontroller 604 has the function of managing transmitter 600 in accordance with a programmed logic stored inside it and described below. It receives the information from at least one pressure sensor 605, a voltage measuring device 606 and preferably also from an accelerometric switch 602. Microcontroller 604 processes the information received and sends it to a transmitter circuit 607 which in turn irradiates it by means of an antenna 608.

Pressure sensor 605, which measures the inflation pressure of the tyre, is for example the sensor SM5310-060AH manufactured by Exar. It consists of a temperature-compensated pressure sensor. In order to reduce the consumption of the power supply current, pressure sensor 605 is powered only when microcontroller 604 requires a reading.
Voltage measuring device 606, which is connected directly to battery 601, will be read by microcontroller 604 whenever the charged status of battery 601 is required.

Accelerometric switch 602, for example the model 6200-9 manufactured by Aerodyne, depending on the movement sensor, has contacts which automatically close when a predefined acceleration value is reached. When the wheel starts to move and accelerometric switch 602 reaches the predefined acceleration value, for example of 1.5 g, it closes its contacts, thus informing microcontroller 604 that the vehicle is moving. By way of alternative to accelerometric switch 602 it is possible to use other movement sensor models, preferably of the type which are not sensitive to the

force of gravity, for example of the piezoelectric type.

Transmitter circuit 607 is a circuit which is frequency-stabilized by means of a SAW (Surface Acoustic Wave) resonator, at the frequency of 433.92 MHz. It is connected directly to battery 601 so as to be able to have the maximum voltage available. It is able to deliver a power of about 4 mW, with ASK (Amplitude Shift Key) type modulation.

Antenna 608 is made with a short section of wire, the length of which depends on the transmission frequency; in the case of a transmission frequency of 433.92 MHz it is about 5 cm long.

Figure 2 shows the block diagram of receiving section 700 of the device for checking the air pressure of the tyres. It is an electronic circuit powered by the car battery. The signal is received by antenna 701 which is connected to a receiver 702 (for example the model RXNB-CE/433 manufactured by Auriel). The received signal, suitably converted, is sent to a microcontroller 703 (for example PIC16LC711 manufactured by Microchip). Microcontroller 703 drives, in accordance with the program recorded in it, a display system 704 for the information received. Display system 704 may be constructed in two versions, which can be automatically detected by microcontroller 703 on the basis of the current consumption. A first embodiment of display system 704 comprises a pair of LED diodes for each wheel, which indicate respectively, by means of a change in colour, that the tyre has a pressure lower than a value predefined beforehand and that the battery powering transmitter 600 is becoming discharged. A different embodiment in accordance with the invention comprises a display device which indicates, in digital form, the pressure value of each tyre and the battery voltage value.

Microcontroller 703 automatically adapts itself to used display system 704, choosing the corresponding driving method.

The system for checking the air pressure in accordance with programs stored in microcontrollers 604 and 703 operates in the manner described below.

When the motor vehicle starts to move and the centrifugal force reaches 1.5 g, which corresponds to about 8 km/h, transmitter 600 is energised, microcontroller 604 reads the value of pressure sensor 605, the voltage value of battery 601 and transmits the information 14 times in succession. At this point, in order to save the battery power, microcontroller 604 assumes a completely inactive state for a first predefined period of time (for example 2.3 s); during this period only the memories and a timing oscillator (inside microcontroller 604) remain functional. At the end of this first period, it checks whether a second predefined period of time (an interval which defines the time between successive sensor reading operations), for example 3 minutes, has lapsed; if it has not lapsed, it assumes again the inactive state for a period of time for example equal to the preceding time; if it has lapsed, it reads the pressure sensor again. In the case where a third predefined period of time (interval between successive transmissions), for example 21 minutes from the last transmission, has lapsed, or in the case where a pressure difference between the last measurements performed which is greater than a predefined threshold is detected, it performs a new transmission (preferably 14 times in succession) of the correlated information.

In order to prevent the transmissions of various transmitters 600 from overlapping with each other, they are temporally staggered. In particular, the plurality

of transmitters 600 installed on a motor vehicle has an identification number. Each identification number has, associated with it, a predefined delay time which is proportional thereto. The transmission of the signal takes place at the previously defined transmission time (21 minutes or when a malfunction occurs) plus the previously defined delay time. In this way the transmissions are temporally staggered with each other and do not overlap, avoiding the possible loss of information.

When the motor vehicle stops and accelerometric switch 602 opens its contacts, microcontroller 604 ensures that the circuits of transmitter 600 are energised and remain in operation for a further predefined period of time, for example between 30 minutes and 2 hours, following which they are switched to a completely inactive state until the motor vehicle starts to move again. In this way, it is possible to distinguish between temporary stops of the vehicle (for example, stops at traffic lights or in queues of traffic), where the system must remain operational, and prolonged stops (for example in car parks), where the system may be switched off.

On account of distortion of the signal due to reflection of the radio signal or drops in the carrier caused by rotation of the wheel and therefore a continuous change in the position of the antenna (different polarisation of the two transmission and receiving antennas) or interference of an electromagnetic origin, the signal may reach receiver 702 in a distorted or incomplete form. Measures have therefore been introduced in order to limit any possible incorrect interpretation of the signal received.

The information is transmitted by transmitter 600 by means of an ASK type modulation, via successive

sequences of bits where the total number of bits of a sequence is equal to 26, and comprises a start bit with a duration equal to 120% of the bit period.

Each transmission performed by each transmitter 600 is repeated a predefined number of times, for example 14 times in succession.

Microcontroller 703, by means of a logic recorded in the memory, for example by verifying the duration of the period of the single bit and of its half-cycle, analyses the first sequence of bits received and, only if all the bits which form it are within a predefined tolerance, is the entire transmission accepted. Should one or more bits be outside of the tolerance range, the sequence of bits will not be accepted entirely, but only the value and the position of those bits correctly received will be accepted and stored. Receiving the same signal 14 times in succession, the system will be able to reconstruct the entire sequence, adding into the memory the bits missing initially, but received subsequently, during the whole sequence of fourteen transmissions. When the tyres, and therefore the associated devices for checking the air pressure (transmitters 600 and receiver 700) are mounted on a motor vehicle for the first time, initialisation thereof is automatically performed. The tyres, once they start to move, transmit the information as described above. Microcontroller 703 stores the identification code of the transmitters - and therefore of the wheels - present on the motor vehicle. Microcontroller 703 is programmed so as to compare this identification code with that of the successive transmissions and to accept only the code received several times in succession, discarding the incorrect identification codes (different from those stored during initialisation) for example transmitted by another motor vehicle which has the same pressure control system and is present in the vicinity. This

function is always active so as to prevent the transmission of any transmitter not belonging to the motor vehicle entering into the control system of the vehicle itself. Moreover, as a result it is not necessary to perform any manual initialisation of the air pressure checking devices in the event of replacement of one or more tyres and/or the transmitters.

Transmitter 600, including the batteries, is preferably formed and contained in a cylindrical shaped container 801, as shown in Figure 3. It has a thread 802 (for example M 16, pitch 0.75) so as to be able to be fastened to a threaded bush 21, and a flange 803 which comes into abutment with bush 21. The measurements of this container 801 without flange 803 are 14.75 mm for the external diameter and 30 mm for the length, for an overall weight of about 10 grams.

Threading 802 allows rapid replacement of transmitter 600 in the event of maintenance thereof. Moreover, mounting of transmitter 600 may be performed at the time of assembly of the inner tube in the tyre, thus avoiding possible damage during movement of the inner tubes.

Figure 4 shows a cross section through an inner tube 900 of a tyre according to a preferred embodiment of the present invention. It shows a transmitter 600 mounted on a threaded bush 21 and an inflation valve 450 of the traditional type. Inflation valve 450 comprises a base 451 which has, inside it, the activation mechanism for the inflating and deflating operations, and a cylindrical casing 452 (stem) fixed to base 451.

Stem 452 of the valve is usually housed in a special hole provided on the bottom surface of the rim and more precisely on the wall of the well, from which it

protrudes into the external environment, at atmospheric pressure, with the corresponding end closed by a cap.

Transmitter 600 for checking the air pressure in the tyres of a motor vehicle is mounted on said conventional inner tube preferably in a diametral position (at 180°) with respect to inflation valve 450 so that the weights are distributed in a balanced manner such that the tyre is not unbalanced during rotation.

Preferably, transmitter 600 is located in the radially internal wall part (on the intrados surface) of inner tube 400 so as to face towards the central well of the rim onto which the inner tube and the tyre will be mounted. In this way there is sufficient space to contain the projecting part of transmitter 600 and bush 21; moreover, they do not come into contact with the radially internal surface of the tyre, avoiding possible damage both to the tyre (abrasions) and to transmitter 600.

In Figure 5, reference sign 1 denotes in a partial cross sectional view a wheel for vehicles comprising a tyre 2, a rim 3 and an inner tube 4 inserted into the cavity defined between tyre and rim.

Tyre 2, in the example shown, is of the conventional type and in any case is of limited importance for the purposes of the invention; it comprises a toroidal carcass 5, side walls 6 terminating in a pair of beads 7, a tread band 8 provided on its radially external surface with a suitable tread pattern including recesses 100 and sipes 105 and, if necessary, a belt structure 50 arranged in between, on the crown of the tyre, between carcass and tread band, this structure usually comprising a plurality of rubberised fabric strips which are radially superimposed and reinforced with textile or metal cords which are parallel to each

other in each strip and intersecting with respect to the adjacent strips and preferably arranged parallel to the equatorial plane in the radially outermost strip.

Rim 3 comprises a bottom surface 9 provided with a central well 10 and two bead seats 11 which are lateral with respect to the well and against which the beads of the tyre rest in abutment; each seat is defined axially between a radial end surface (shoulder) 12 in an axially external position and an annular axially internal projection 13.

A hole 44, inside which a common inflation valve 90 for tubeless tyres is mounted, is advantageously formed in the wall of well 10.

Inner tube 4 is preferably moulded and vulcanized in a toroidal shape so as to memorise this shape: in other words, when subject to mechanical stresses which deform it, it is able to produce elastic reactions designed to ensure that it reacquires the original undeformed shape. In particular, and more preferably, the inner tube is moulded and vulcanized with a toroidal shape having an internal volume not less than one third of the final volume of use.

It is particularly advantageous, for tyres with a "low profile", to use an inner tube (Figure 6) which is preferably divided into two circumferential compartments A and B which are separated by a central wall 110 of greater rigidity than side walls 115, such as that described in European Patent Application No. 97EP830600.9 filed by the Applicant.

This inner tube is divided into at least two separate circumferential parts, separated by a longitudinal wall, providing said wall, and preferably also the zone surrounding it, with a greater rigidity than the more axially external part, i.e. the side walls of the inner

tube, so that, during inflation of the tube inside the tyre, the expansion of the tube in the axial direction is greater than in the radial direction so as to bring its central portion into contact with the zone of the tread at the same time as completely adapting the sides to the side walls of the tyre, thus avoiding the generation of abnormal tensions in the walls of the tube.

This inner tube may be preferably obtained by forming the sides of the inner tube separately from the central part thereof, then joining together the separate parts, advantageously by means of chemical adhesion of the associated elastomeric materials during vulcanization of the inner tube.

The inner tube may be formed in any other convenient manner and may be of any type, both single-volume and with a number of compartments greater than two, however arranged.

For the purposes of inflation and deflation of the compartments into which the inner tube is divided, each compartment will be provided with an associated device 14 (Figure 5) which does not have any parts for connection to the external environment, which pass through the rim.

This device 14 is advantageous during conditions of rapid acceleration of the vehicle, where there is the possibility that the tyre may slip with respect to the rim with the consequent high risk of tearing of the inner tube at the base of the valve or shearing of the stem of the valve, with consequent immediate deflation of the tyre and corresponding loss of stability of the vehicle, thereby seriously endangering the lives of the driver and of the passengers of the vehicle itself.

Device 14 for inflating, deflating and calibrating the

inner tube comprises a rigid body 15 which is preferably made of plastic material or light metal alloys. Rigid body 15, which preferably has a cylindrical configuration, is mounted inside a special threaded bush 21 (Figure 6) defining a circular through-opening formed in the elastomer material of the radially internal (intrados) surface of the inner tube.

Preferably, abovementioned rigid body 15 (external diameter 14.75 mm and length 30 mm) comprises an annular portion of its threaded external surface (for example thread M 16, pitch 0.75), so as to allow it to be screwed into bush 21, and a base flange 20 which allows its position to be fixed with respect to the bush. Rigid body 15 has an overall weight of about 10 grams.

As can be clearly understood from Figures 5 and 6, abovementioned rigid body 15 is completely devoid of any parts for connection to the environment outside the wheel. Moreover, the inner tube provided with this device is free to move into any position inside the cavity defined by the tyre and the wall of the rim.

In particular, inflation of the inner tube is performed by introducing air under pressure into the space between tyre and rim, so as to deform the tube with respect to its initial configuration, thus creating a pressure difference between the internal volume of the tube and the external space, pending therefore restoration of the equilibrium between the pressures in the abovementioned environments, corresponding to the return of the tube into its original undeformed configuration. Subsequently the air present outside the tube is allowed to flow into the surrounding atmosphere, thus allowing expansion of the tube itself until it fills entirely the cavity between tyre and rim.

Then, the correct and predefined value of air pressure inside the chamber is reached by releasing the air which is in overpressure with respect to the desired value, by means of a device which is suitably calibrated to said value.

The valve, which does not have any parts for connection to the external environment, may also comprise one or more independent (inlet, calibration and discharge) elements which are separate from one another, and may also not have some of said elements.

Figure 7 shows a cross section through an inner tube 900 of a tyre according to an embodiment of the present invention, in which it is possible to note a transmitter 600 which is mounted on a first threaded bush 21 and a device 14 for inflation, deflation and calibration of the inner tube, which is mounted on a second threaded bush 21 which is preferably located in a diametrically opposite position (at about 180°) from the former for a balanced distribution of the weights.

Preferably, device 14 and transmitter 600 are positioned towards the inside of inner tube 900 so that, when mounted on the respective rim, they face the central well of the rim itself. In this way there is sufficient space for housing these devices.

Figure 8 shows a cross section through an inner tube 1000, which is divided into two circumferential compartments A and B, in accordance with a further embodiment of the present invention. A transmitter 600 is mounted on a first threaded bush 21 of compartment A and an inflation device 14 is mounted on a second threaded bush 21 of compartment A located at 180° from the former so as to balance the weights.

For an inner tube 1000, which is divided into two circumferential compartments A and B, two inflation

devices 14 are necessary, namely one for each compartment. A single transmitter 600, on the other hand, is sufficient to detect the variations in pressure of the two compartments of the inner tube.

In the case where only one transmitter 600 is used, it is preferable to use a balancing device 1001 to balance the weights of inner tube 1000. In this case an inflation device 14 is mounted on a first threaded bush 21 of compartment B and a balancing device 1001 is mounted on a second threaded bush 21 of compartment B located at 180° from the first one so as to balance the weights.

Balancing device 1001 preferably consists of a container of the same type as the container 801 and preferably having the same weight as the other elements mounted on the inner tube, with the aim of balancing and distributing uniformly the weights of the inner tube and hence of the tyre.

A greater degree of sensitivity may be obtained with two transmitters 600, i.e. one for each compartment.

CLAIMS

1. System for checking the air pressure in the tyres of a motor vehicle, comprising:
- at least one vehicle tyre wheel, said wheel comprising a tyre mounted on the corresponding mounting rim, defining a toroidal cavity;
- an inner tube inserted in said toroidal cavity;
- a device for detecting the pressure of said inner tube;
- a transmission device designed to transmit a signal indicating the value of said pressure;
- a receiving device designed to receive said signal indicating the pressure value; and
- a device for displaying said signal indicating the pressure value,
characterized in that said transmission device is inserted in said inner tube.

2. System according to Claim 1, characterized in that said transmission device is inserted in a wall of said inner tube in a radially internal position.

3. System according to Claim 1, characterized in that it comprises a bush fixed in the wall of said inner tube, with said transmission device mounted on said bush.

4. System according to Claim 1, characterized in that said transmission device comprises said pressure detector.

5. System according to Claim 1, characterized in that it comprises an inflation device inserted in a wall of said inner tube.

6. System according to Claim 5, characterized in that said transmission device is inserted in a wall of said inner tube in a diametrically opposite position with respect to said inflation device.

7. System according to Claim 5, with said toroidal cavity which can be isolated from a surrounding environment at atmospheric pressure, characterized in that said inflation device does not have any parts for connection to said surrounding

environment at atmospheric pressure, which are designed to fix the circumferential position of said inner tube with respect to said rim.

8. System according to Claim 7, characterized in that it comprises an inner tube with at least two compartments which are independent of each other and each provided with said inflation device.

9. System according to Claim 8, characterized in that said inner tube comprises two inflation devices and one transmission device.

10. System according to Claim 7, characterized in that said inflation device comprises a rigid body incorporating an inflation valve, a calibration valve and a discharge valve.

11. System according to Claim 1, characterized in that said transmission device comprises a supply battery and a device for measuring the voltage of said battery and transmitting the value of the measured voltage by means of a radiofrequency signal.

12. System according to Claim 1, characterized in that said transmission device comprises a movement sensor which is designed to indicate rotation of said wheel so that said transmission device is energised when the wheel is moving.

13. Method for checking the air pressure in the tyre of motor vehicles by means of a transmission device designed to transmit at radiofrequency a signal indicating the value of said pressure, characterized by the fact of mounting said transmission device on said inner tube in a radially internal position.

14. Tyre wheel for vehicles, comprising:

- a tyre mounted on the corresponding mounting rim, defining a toroidal cavity;
- an inner tube inserted in said toroidal cavity;
- a transmission device designed to transmit at radiofrequency a signal indicating the pressure value of said inner tube,

characterized in that said transmission device is inserted in a wall of said inner tube.

15. Inner tube for tyres of vehicle wheels, which is elastically expandable by introducing fluid under pressure into its internal volume, comprising a device for introducing and extracting said fluid respectively into and from said internal volume, and a device designed to transmit at radiofrequency a signal indicating the pressure value of said inner tube, characterized in that said transmission device is inserted in a wall of said inner tube.

ABSTRACT

A system for checking the air pressure in the tyres of a motor vehicle, comprises a tyre mounted on the corresponding mounting rim, so as to define a toroidal cavity, an inner tube inserted in said toroidal cavity, a device for detecting the pressure of said inner tube, a transmission device designed to transmit at radiofrequency a signal indicating the pressure value of said inner tube, a receiving device designed to receive said signal indicating the pressure value, and a device for displaying said signal indicating the pressure value, mounted on the vehicle, and is characterized in that said transmission device is inserted in a wall of said inner tube.

Fig. 5

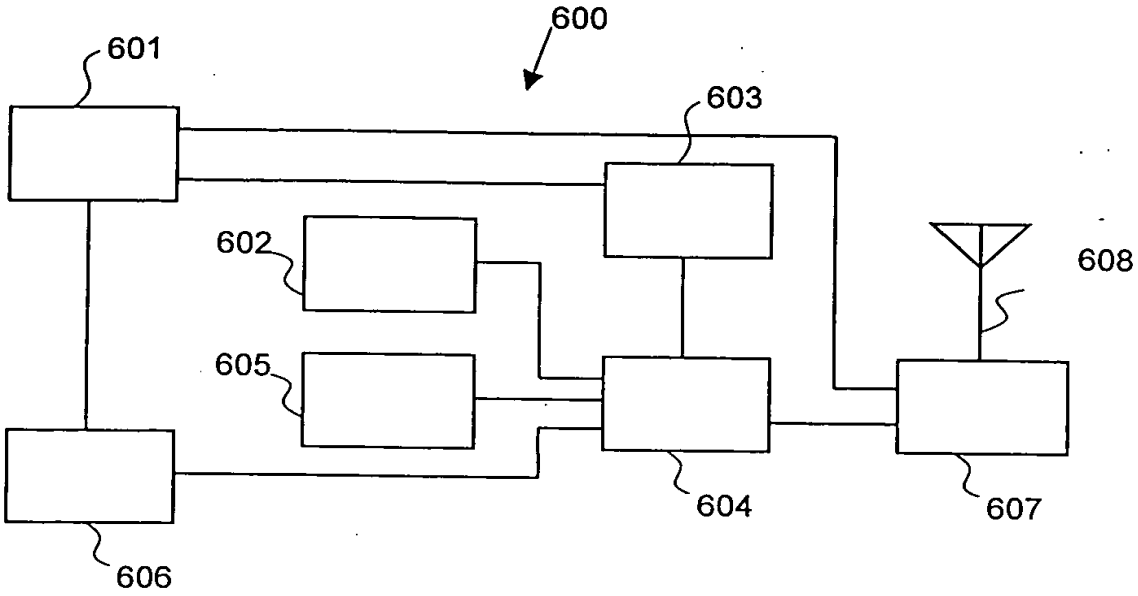

Fig. 1

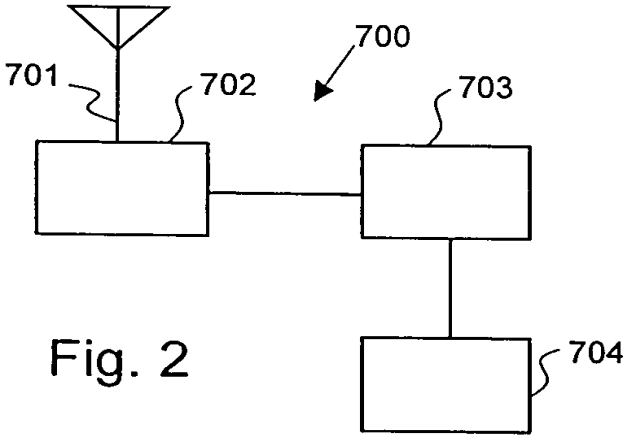

Fig. 2

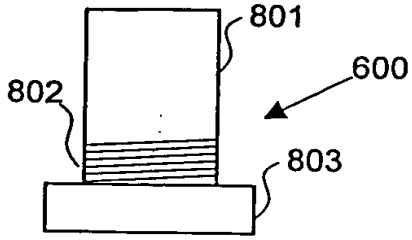

Fig. 3

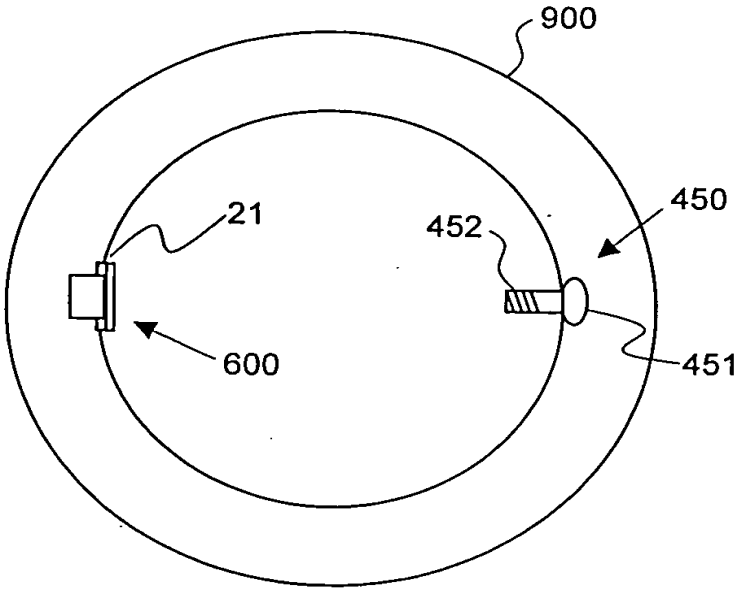

Fig. 4

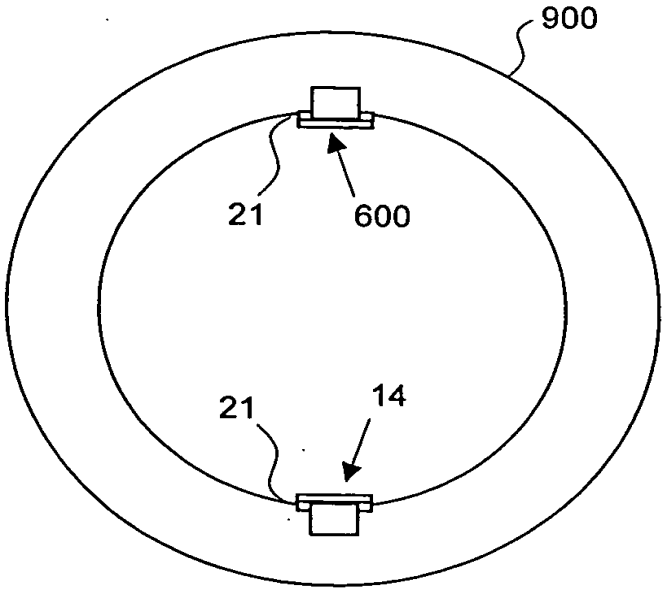

Fig. 7

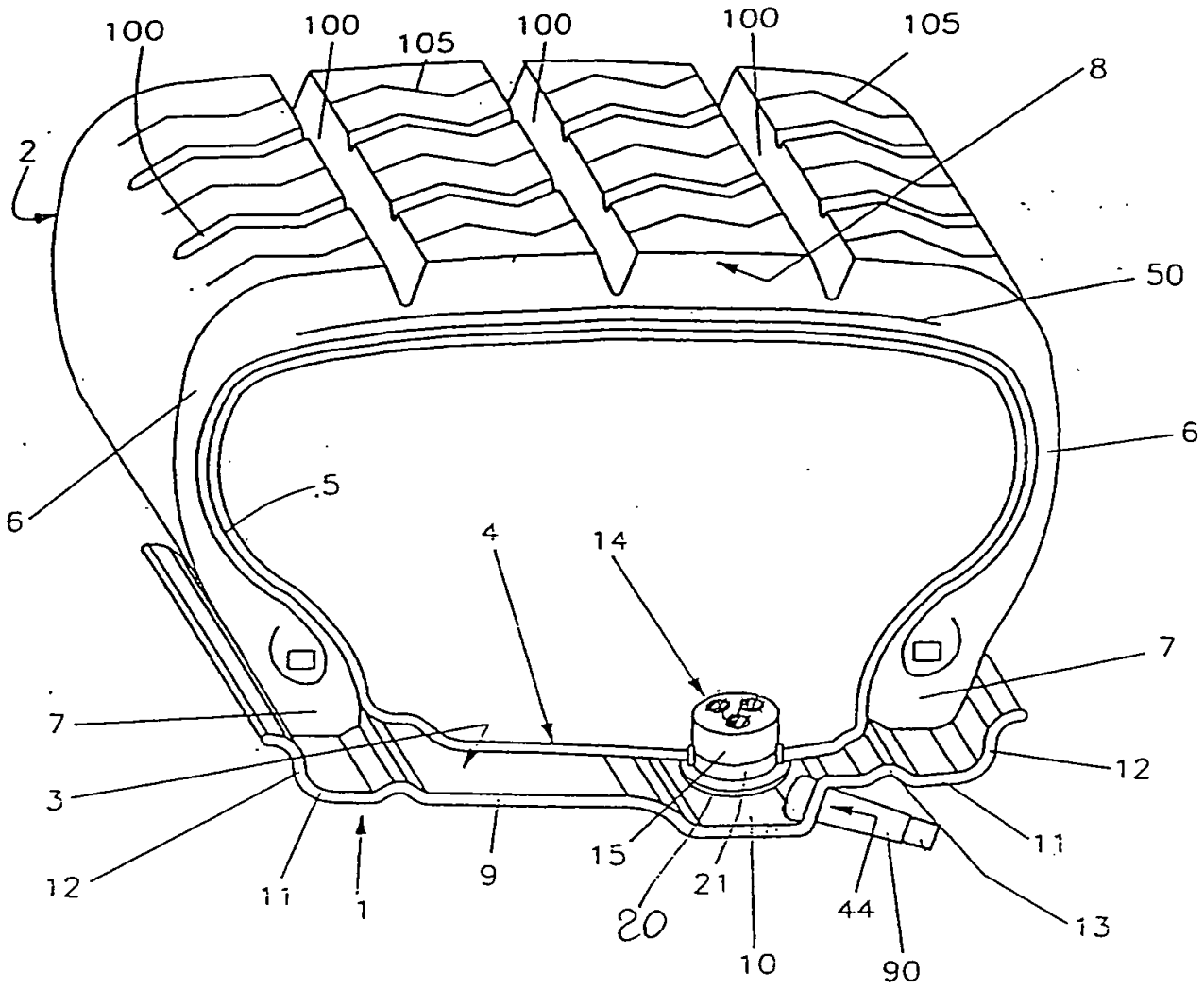
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Fig. 5

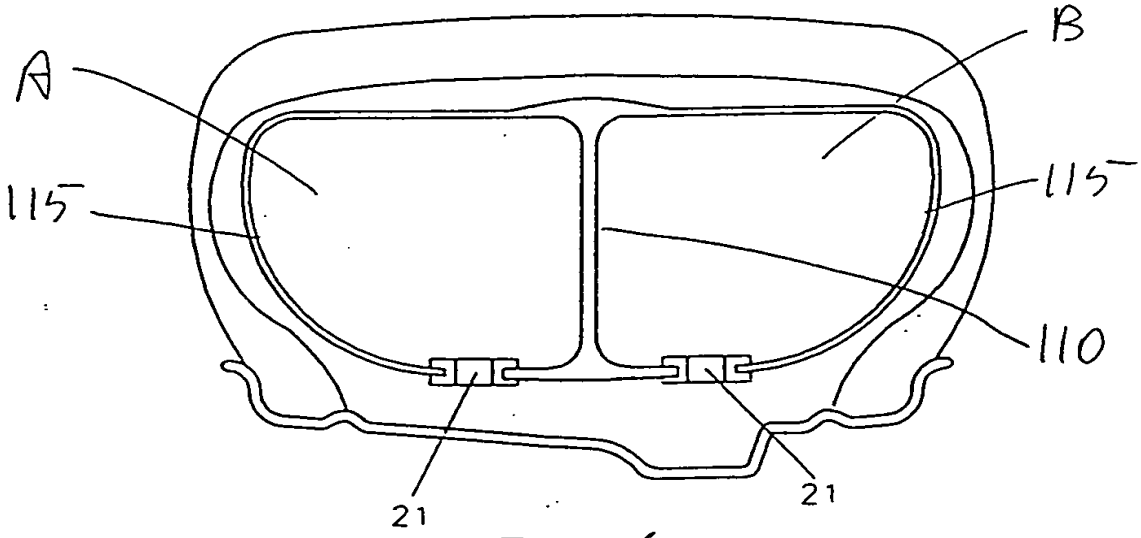
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Fig. 6

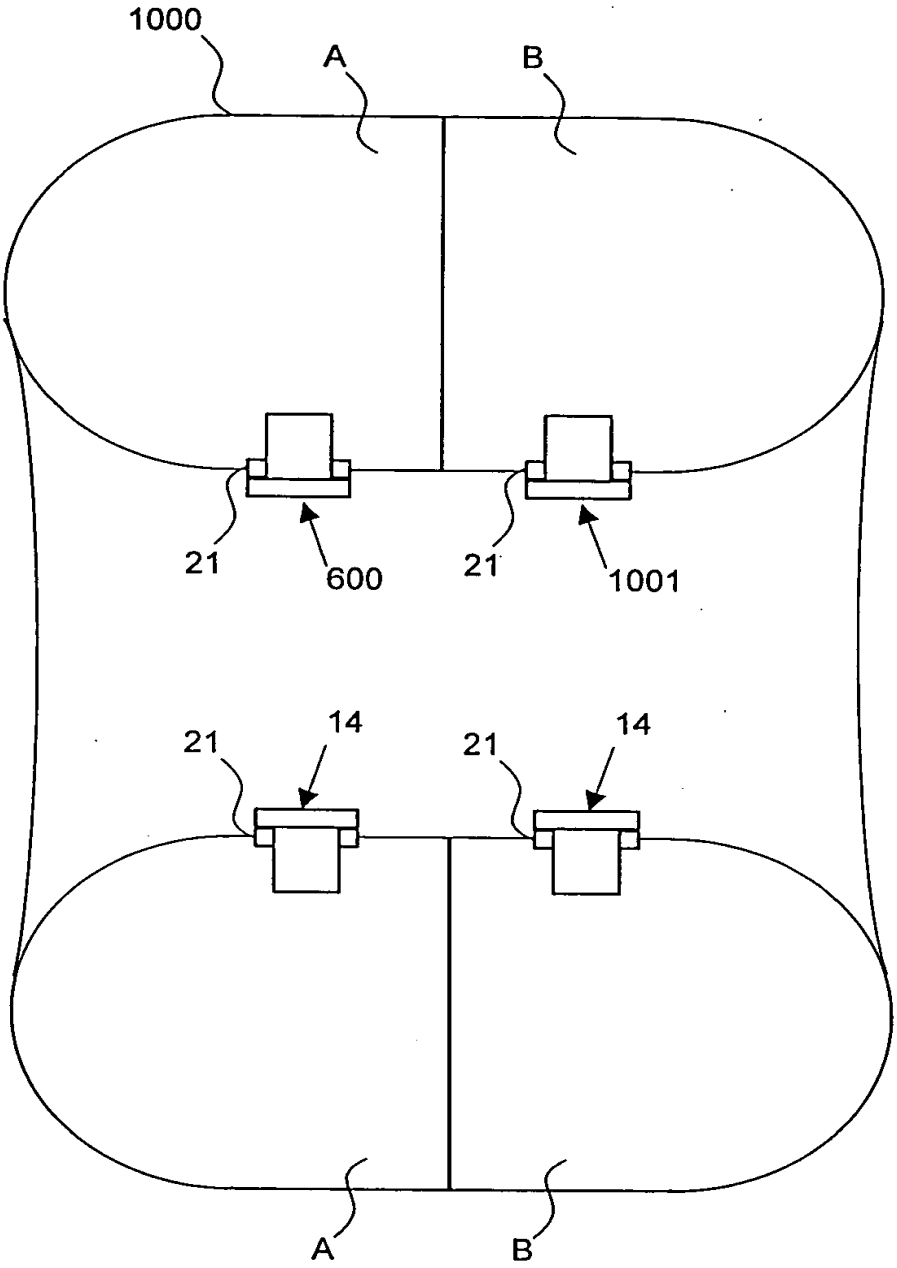

Fig. 8